DOI: 10.1007/s11676-007-0037-5

Comparison of ecological condition and conservation status of English yew population in two Austrian gene conservation forests

DHAR Amalesh *, RUPRECHT Herwig, KLUMPP Raphael, VACIK Harald

Institute of Silviculture, Department of Forest and Soil Sciences, University of Natural Resources and Applied Life Sciences, Peter-Jordan Str. 82, A-1190, Vienna, Austria.

Abstract: English yew *Taxus baccata* L. has been catalogued as endangered tree species and prone to extinction in Austria as well as many other parts of Europe. The present work is based on the comparison of the natural population of two gene conservation forests from different geographic locations in Austria where the spatial structure, regeneration status and possible conservation measures are examined. The pole stand distribution varied distinctly in each sites. The total no of individuals per ha (DBH ≥5 cm), average DBH and average height were 492 n·hm^{-2}, 8.8 cm and 6.3 m in Stiwollgraben whereas in Leininger Riese 45 n·hm^{-2}, 16.3 cm and 7.6 m respectively. Over 79% of the Stiwollgraben population were represented the good health condition, while in Leininger Riese it was less then 49 % which means population of Stiwollgraben is in better condition compared to Leininger Riese. The sites differed considerably in the pattern of regeneration but pattern were consistent with the dynamics depicted by the age distribution. Considering the one-year-old seedlings Stiwollgraben contains 13 019 individuals·hm^{-2} whereas Leininger Riese only 1 368. Surprisingly there were no any saplings in respect of 51 to 150 cm height classes in both sites and 30 to 50 cm in Stiwollgraben. In that context the conservation of English yew on the forest level may require well-managed reserves and long-term rotations between harvest events, protection from the herbivore and reduction of competition, which will enhance the long-term viability of the species.

Keywords: Endangered species; *Taxus baccata*; Population structure; Forest management; Conifers

Introduction

The English yew (*Taxus baccata* L) is a slow-growing, long-lived, shade loving evergreen conifer tree species in temperate forests. It is scattered throughout Europe (Bolsinger and Llody 1993), northern Africa (Sauvage 1941) and the Caspian region of southwest Asia (Mossadegh 1971). It has gained considerable importance as a source of anti-cancer drug and high aesthetic value of timber. The main reasons for the decline of yew are widespread deforestation, light competition, selective felling of yew and browsing by herbivore (Bugala 1978; Tittensor 1980; Haeggström 1990; Jahn 1991).

Despite of its poisonous properties yew is very vulnerable to browsing and bark stripping by rabbits, hares, deer and domestic animals such as sheep and some other cattle (Kelly 1975; Haeggström 1990; Dhar *et al.* 2006b). Indeed *T. baccata* is one of the grazing sensitive trees (Kelly 1975) and there is a strong negative effect on recruitment and adult survival if the area is densely deer populated (Kelly 1981; Mitchell 1988). Similarly, *T. Canadensis* Marsh. is declining in abundance in the Great Lakes region due to heavy deer browsing (Gill *et al.* 1995).

Another most important factor is light, although yew is shade tolerant (Korl 1975, Brzeziecki and Kienast 1994). However, seedlings are hindered and saplings often die or show poor growth when yew grows beneath the shade of Beech (Czatoryski, 1978, Pridnya 1984). Moreover it is mandatory for natural regeneration of yew. Some other contributory factors are (1) adverse soil condition, (2) loss of genetic variation, (3) illegal cutting and lack of people awareness, (4) unfavourable site conditions (Thomas and Polwart 2003) like damaged caused by fungi (Strouts 1993), insect pests which restrict the yew recruitment and so on.

Population of slow growing long-lived plants like English yew typically received little attention in the past. Due to less awareness, this species is now catalogued as a rare and endangered species prone to extinction from all over the Europe (Thomas and Polwart 2003). There are two general conservation strategies for slow growing long living species, which are rare and endemic to small geographic areas. On the one hand most plans for management of such species have focused on land protection with the goal of protecting established individuals (Cardel *et al*. 1997). Secondly, the conservation efforts have focused on the reinstitution of ecological processes, which are important for recruitment of new individuals. These efforts promote successful regeneration and increase the genetic diversity on the long run (Barrett and Kohn 1991). However, these two conservation strategies may not be sufficient if population of slow growing, long lived plants are predicted to be in long term declines (Kwit *et al*. 2004).

At present yew is a rare and endangered tree species in Austria (Niklfeld 1999; Schadauer *et al*. 2003; Russ 2005) with restricted

Received: 2007-06-25; Accepted: 2007-7-27

Electronic supplementary material is available in the online version of this article at http://dxdoi.org/10.1007/s11676-007-0037-5
Biography: DHAR Amalesh, male, in Institute of Silviculture, Department of Forest and Soil Sciences, University of Natural Resources and Applied Life Sciences, Peter-Jordan Str. 82, A-1190, Vienna, Austria.
*Corresponding author (amalesh.dhar@boku.ac.at)
Responsible editor: Chai Ruihai

occurrence due to human activities, over uses in the past, browsing pressure, unsuccessful regenerations (Scheeder 1994; Meinhardt 1996; Dhar *et al*. 2006b). The gene conservation forest network in Austria has developed a programme to maintain the biodiversity of endangered species in Austria (Müller and Schultze 1998). The primary focus of these conservation strategies is the *in-situ* conservation of rare tree species by silvicultural treatments (Herz *et al*. 2005). There are a limited number of studies on the management of yew populations in gene conservation forests until now (e.g. Vacik *et al*. 2001; Dhar *et al*. 2006a).

In this contribution, we compared the ecological condition of two Austrian gene conservation forests and developed conservation management recommendations for these endangered populations.

Materials and methods

Characterisation of the study areas

The study site Stiwollgraben is situated in the eastern Alpine mountains (Fig. 1) with estimated 4.6 hm^2 of land. The slope of the site is 53 % to 75 %, west exposition and 580 to 700 m a.s.l. elevation. The soil type is dominating substrate dolomite and sandy rock. The area mainly dominated by an irregular micro relief with a mull/moder humus layer. The annual average rainfall and temperature is 1 060 mm and 7.7°C, respectively.

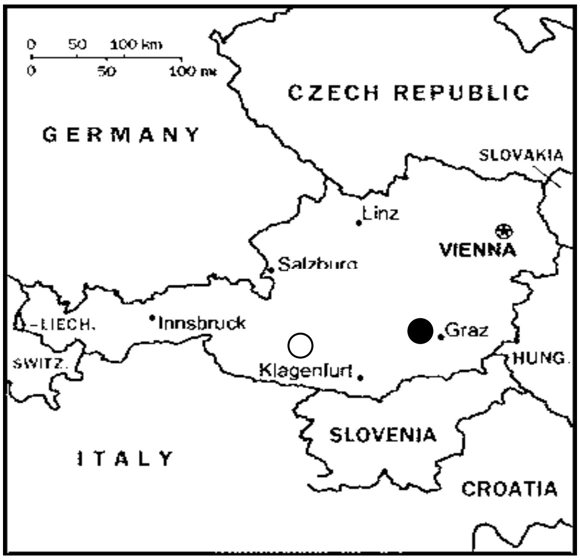


Fig. 1 Map showing the Location of two study sites Stiwollgraben (•) and Leininger Riese (o)

The pole stand of Stiwollgraben is a mixture of *Fagus sylvatica* L., *Picea abies* L. Karsten, *Pinus sylvestris* L., *Taxus baccata* L., *Larix decidua* Miller as well as some *Abies alba* Miller, *Acer pseudoplatanus* L., *Ulmus glabra* Hudson, *Fraxinus excelsior* L. and *Sorbus aria* L. Crantz. In case of regenerative stage *Picea abies*, *Taxus baccata*, *Fagus sylvatica*., *Acer pseudoplatanus*. and *Fraxinus excelsior* are the dominating species.

According to Dhar *et al*. (2006a) the local foresters performed three different forest operations: intensive thinning (T I) with a removal of 56 % and moderate thinning (T II) with a removal of 27 % of the stocking volume and third activity with no thinning (T III). A fence was established on a part of the experimental area to examine the effects of browsing. The fenced area is almost 1.31 hm^2 and covers all three treatments (T I: 0.49 hm^2, T II: 0.37 ha and T III: 0.45 hm^2) out of 4.6 hm^2.

The second site is in the northern part of the Villacher Alps at Bad Bleiberg (Fig. 1) in the area of that so-called "Leininger Riese" where it can be found at Northern exposition with an elevation of between 940–1160 m a.s.l. The total forest is covered by 18.4 hm^2 of land. The soil contains reddish and light weathered dolomite with a mull/moder humus layer. The annual average rainfall and temperature are 1420 mm and 5.9°C, respectively.

The pole stand consists of *Fagus sylvatica*, *Picea abies*. *Pinus sylvestris*, *Taxus baccata*, *Larix decidua* and *Abies alba*. There was also some moderate selective thinning done due to increase the favourable environmental condition for the yew population and singletree protection for the yew regeneration was applied to reduce the browsing pressure.

Sampling

The study sites were permanently marked with 30m × 30 m for Stiwollgraben (in total 48 plots) and 50m × 50 m for Leininger Riese (in total 72 plots). All individuals of yew in the study areas have been marked and tree height, diameter at breast -height (DBH at 1.30 m), health condition, crown length, foliage percentages, height class, and stem damage with DBH ≥5 cm were recorded. The natural regeneration was investigated according to three different height classes by means of three circular plots with different sizes (1st, 2nd and 3rd circle with a radius of 0.5 m, 1.6 m and 3.2 m respectively). All seedlings, juveniles at two and more years and up to 30 cm height were sampled at the 1st circle, all individuals from 30–50 cm and 51–150 cm height at the 2nd circle and all individuals from 151 cm height up to 4.9 cm DBH at the 3rd circle.

The health condition of each individual English yew was assessed on the basis of percentage of the living crown, the foliage density and the crowns formation (compare Dhar *et al*. 2006b).

Results and discussion

Ecological condition of yew populations

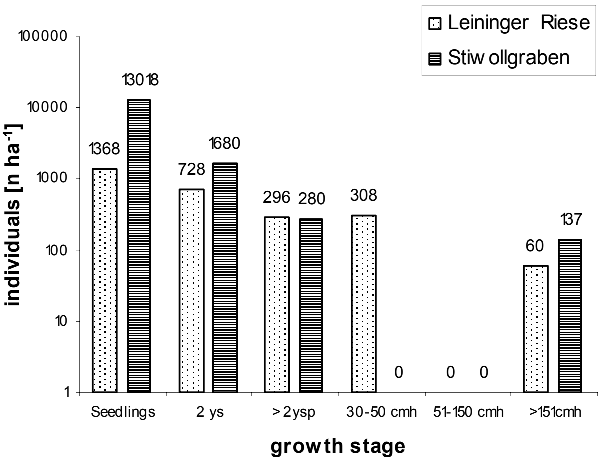
The density of seedlings at different age classes varied distinctly (Fig. 2) from each other's. In Stiwollgraben it was observed that the number of 1-year-old seedlings (13 018 $n{\cdot}hm^{-2}$), and two years seedlings (1 680 $n{\cdot}hm^{-2}$) whereas in Leininger Riese, the number of 1-year-old seedlings (1 368 $n{\cdot}hm^{-2}$) and 2 years seedlings (728 $n{\cdot}hm^{-2}$). In regards to sapling stage (>2 years) Leininger Riese (296 $n{\cdot}hm^{-2}$) consists of a higher number than Stiwollgraben (280 $n{\cdot}hm^{-2}$). It is mentionable that there are no any saplings with respect to 51 to 150 cm height classes in both sites and 30 to 50 cm height class in Stiwollgraben.

The populations' structures of both sites are given in Table 1. The estimated population size (individual trees with a DBH ≥5 cm) is 2 236 individuals in Stiwollgraben and 828 in Leininger Riese. The average DBH and height as well as the average crown percentages are quite similar at both sites which were 8.8 cm, 6.3

m and 62 % in Stiwollgraben whereas 16.3 cm 7.6 m and 65 % in Leininger Riese respectively. In that context Leininger Riese shows a wider range of DBH distribution compared to Stiwoll graben (Fig. 3). In respect of health condition Stiwollgraben shows a very good condition, more than 79 % of the total yew population are very vital to vital whereas in Leininger Riese only 49 % are vital to very vital condition (Fig. 4). Regarding the analysis of the vitality of single trees it revealed the fact that there are considerable differences between the populations of Stiwollgraben and the Leininger Riese. According to Lilipop (1931), Krol (1975) and Brzezieck and Kienast (1994) yew is highly shade tolerant and can easily grow under shade condition. Also the adult trees of the yew population at both two sites indicate a quite remarkable condition in relation to the competition with other tree species in the overstory. Although yew reproductive activity can be enhanced by better light availability (Svenning and Magard 1999).

Table 1. Population structure of English yew in two Austrian gene conservation forest

Treatment	trees ≥ 5 cm DBH (n·hm^{-2})	Average. tree height (m)	Average. DBH (cm]	max. DBH (cm)	ave. canopy closure for Adult (%]	ave. crown (%]	basal area (m^2·hm^{-2})	tree volume [m^3·hm^{-2}]	Ave. seed weight (g)
Stiwollgraben	492	6.3	8.8	24.8	84	62	3.20	17.3	63.97
Leininger Riese	45	7.6	16.3	40.9	68	65	1.04	5.05	62.98



2ys= 2 years seedlings, > 2ysp= > 2 years saplings, 30-50 cm h = 30-50 cm height, >151cmh = 151 cm height and up to < 4.9 cm DBH

Fig 2. Regeneration status of *Taxus baccata* population in Leininger Riese and Stiwollgraben

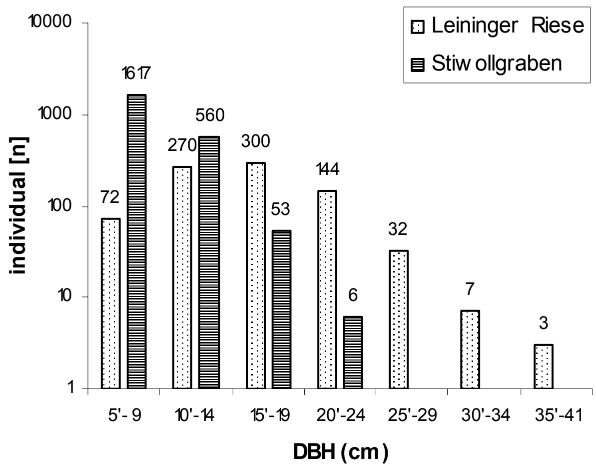


Fig. 3 Histograms showings the diameter distribution of English yew population in two Austrian gene conservation forest

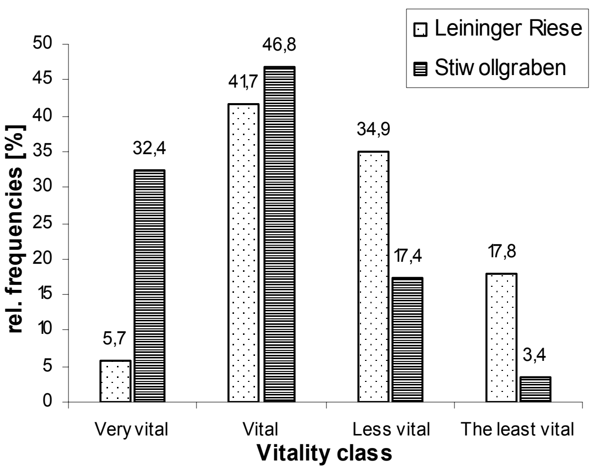


Fig 4. Vitality of yew population in Leininger Riese and Stiwollgraben

The sex ratio of the fertile individuals of both sites showed differences (Table 2). The yew population of Stiwollgraben was female-biased (1.56) up to now whereas Leininger Riese was male baised (0.91). So, sex-biasness is obviously a general phenomenon in yew. Williamson (1978) reported that a large yew population in Kingley Valley in England was male-biased whereas Svenning and Magard (1999) mentioned that population of Munkebjerg was female-biased. However, it is important to consider, that 36 % of the total Stiwollgraben population is unidentified. Sex identification is very difficult for yews due to its dioecious sexual system. A full identification of each individual is still in progress, which could have some effects on the sex ration.

The status of yew seedlings, saplings and adults represented considerable differences in both sites (see Table 3). In case of Stiwollgraben it showed that the number of seedlings was 14 699 n·hm^{-2}, saplings 417 n·hm^{-2} whereas at Leininger Riese were 2 096 n·hm^{-2} and 664 n ha^{-1} respectively. It is also mentionable that almost 78 % of total saplings from Stiwollgraben were under dense canopy (≥ 90 %) while in Leininger Riese it was only 43 % of total saplings. A dense canopy has negative effects on

growth and survival of yew saplings (Svenning and Magard 1999; Iszkulo *et al*. 2005; Boratysski *et al*. 2001). According to Iszkulo and Boratyński (2006) yew seedlings could germinate and grow in very shady conditions but their light demand increase with the increase of age. As there is no significant relationship between the canopy closure and the total no ha^{-1} of seedlings and saplings, it can be assumed, that some additional factors might influence the population structure as well.

Table 2. Sex ratios of *T. baccata* population in Leininger Riese and Stiwollgraben

Site	Total no of individuals	Female	Male	undefined	Ratio
Leininger Riese	828	392	432	3	0.91
Stiwollgraben	2236	835	535	866	1.56

Table 3. Status of English yew population in Leininger Riese and Stiwollgraben in respect of different age class

Site	Area [ha]	Density				Ave. canopy closure for saplings < 5 cm DBH with SD (%)
		Total (No·hm^{-2})	Seedlings ≤ 2 years (No·hm^{-2})	Saplings > 2 years (No·hm^{-2})	Adults ≥ 5 cm DBH (No·hm^{-2})	
Stiwollgraben	4.6	15608	14699	417	492	95 (+/-18)
Leininger Riese	18.4	2805	2096	664	45	80 (+/-17)

According to our investigations it was observed that both sites contained an adequate number of yew individuals especially at Stiwollgraben (15 608 individuals·hm^{-2}). With regards to the sapling stage both sites showed shortcomings in the height class of 51 to 150 cm at both sites and from 30 to 50 cm at Stiwollgraben (Fig. 1). These might be caused by several impacts simultanously. Herbivore browsing, less availability of light or interspecific tree competition are reported to be major drivers for the loss of saplings. Haeggström (1990) and Kelly (1981) mentioned that English yew is very susceptible to browsing. On the contrary Hulam (1996) and Krol (1975) stated that seedlings only survive and grow where the canopy is relatively dense and successful sapling recruitment has been associated with an opening of canopy. Similarly Iszkulo and Boratynski (2006) reported that seedlings can survive on deeply shaded sites for 2–3 years, but the light demand increases with an increase in age. In our case no evidence was found for seedlings predation and seedlings did not show any preference for especially protected microsites. However, it can be assumed that the browsing impact is quite severe in both cases, as control measures with fenced areas indicate some differences in the vegetation mixture and seedlings growth potential. Likewise, no autotoxicity was found and recruitment was common even close to large individuals (Dhar *et al*. 2006b). In that context some other factors could be mentioned as causes for a loss of yew seedlings such as cold wind and freezing during the winter. Thick layers of litter are preventing the growth as well as cause the heating of seedlings (Izdebski 1956; Kościelny and Król 1965).

Illegal cutting is another important factor for English yew decline in Austria. Its tough and long-lasting timber was extensively used for building and its high aesthetic appeal made it a popular decorative material from the Ancient time. People are not aware about the importance of yew. So low public awareness are creating another detrimental effect on declining of yew population.

Soil water relation is an important limiting factor. Soil moisture can be an extremely restrictive factor for seedling survival (Małgorzata 2004). Although in our study we had found the moderate fresh water balance in both sides.

Genetic variation is one of the major important factors for the survival of populations in adverse condition. In our study population of Stiwollgraben showed high level of genetic variation and the population of Leininger Riese under investigation and we don't have the result yet.

Although English yew is a damage tolerant species, stem damages increase the susceptibility of other biotic infections. Yew is notably susceptible to *Phytopthera* sp. root diseases (Strouts 1993) and ramorum dieback (*P. ramorum*) (Lane *et al*. 2004). We have observed Gall mite at Leininger Riese whereas in Stiwollgraben was absent.

From the above discussion we have drown Table-4, which is representing the major factors related to yew decline in two Austrian gene conservation forests.

Table 4. Problems related to yew population in two Austrian gene conservation forests

Major problem related to yew declination	Gene conservation forest	
	Stiwollgraben	Leininger Riese
Browsing by herbivore	high	high
Predation by rodent	not measured	not measured
Competition for light	high	high
Genetic variation	high	under investigation
Illegal cutting	present	present
Abiotic damage	present	present
Fungal diseases	not found	not found
Biotic damage (gall mite)	not found	present
Low Public awareness	present	present

Conservation of yew Population

A number of causes regarding the yew declination have been point out in different parts of the paper. From the results of the recent studies the following recommendations can be formulated for management and conservation of English yew populations in Austria:

Yew populations with a minimum size of 500 individuals should be dispersed or connected in the landscape to maintain the viability.

For controlling the browsing pressure, herbivory should be excluded from the forest by establishing fences (Dhar *et al*. 2006b) or reduced in number (if the population size is small).

Fences and single protection measures with shelters were established at both sites to reduce the browsing pressure.

Predation by rodent should be checked scientifically.

Appropriate light and micro climatic conditions (moderate crown closer of the upper story) are needed to maintain the yew population. To maintain the light availability a continuous selective thinning reducing the competition with other tree species is advocated to improve the status of yew population (Czatoryski 1978; Svenning and Magard 1999; Dhar *et al*. 2006a). In our study different types of thinning operation were performed in both sites to find appropriate light requirements to maintain the yew population.

Genetic variation is one of the major important factors for the survival of populations in adverse condition. If the population size is small or the genetic variation is low artificial regeneration could be an important way to increase the genetic variation. Although the population of Stiwollgraben showed high level of genetic variation and population of Leininger Riese under investigation.

Although English yew is a damage tolerant species, stem damages increase the susceptibility of other biotic infections. Careful harvesting operations can reduce the damage during tree felling. However, it is very difficult to take protective measures for fungal or biotic damage. So prevention measures can be the easiest way to control such diseases. It is mentionable that "ringelbaum" (stop growth by cutting the phloem fibres with chainsaw) was done which will remove later on.

Public awareness will help to enhance the knowledge and ecological importance about yew (Vacik *et al*. 2001). Regular information and publications might help to increase the level of awareness and improve the overall knowledge about this species in the general public. Local foresters have been initiating public awareness programme by public media at both sites. Also the presence of research activities at the site has positive effects on the public awareness.

If yew trees need to be cut, it should be done 25 cm above from the ground as yew can produce more sprouting buds from that origin.

The success of yew regeneration should be evaluated by a regeneration survey in 5–10 year cycles. The ongoing monitoring programm at our study sites will help to investigate the regeneration status in future.

Conclusions

For the yew population in Stiwollgraben proper management strategies are applied to maintain its present health condition. On the other hand well-defined management strategies are needed to increase the health condition in Leininger Riese. However, the recommendations which are given are likely to change as new biological information become available they provide an initial framework for developing more comprehensive conservation guidelines for the future investigation.

Acknowledgements

We would like to thank the Forest Province Office of Styria for financial support and also the Österreichische Orient-Gesellschaft (ÖOG) for supporting the studies with a One-World Scholarship.

References

Barrett, S.C.H., Kohn, J.B. 1991. Genetic and evolutionary consequences of small population size in plants: implications for conservation. In: D.A. Falk and K.E. Holsinger (Eds.), Genetics and conservation of rare plants. New York: Oxford University Press, pp3-30

Bolsinger, C.L., Lloyd, J.D. 1993. Global yew assessment: status and some early result. In: S. Scher and Shimon B. Schwarzs child (Eds), Intern. Yew Resources Conference: Yew (*Taxus*) conservation Biology and Interactions. Berkeley, California, Unpublished proceedings.

Boratyński, A., Didukh, Y.P., Lucak, M. 2001. The yew (*Taxus baccata* L.) population in Knyazhdvir nature reserve in the Carpathians (Ukraine). *Dendrobiology*, **46**: 3–8.

Brzeziecki, B., Kienast, F. 1994. Classifying the life-history strategies of trees on the basis of Grimian model. Forest Ecology Management, 69: 167–187.

Bugala, W. 1978. Systematics and viability. In The yew-*Taxus baccata* L. In: Bialobok,S. (Ed.), Foreign Scientific Publications Department of National Centre for Scientific, Technical , and Economic Information, (for the Department of Agriculture and the National Science Foundation, Washington D.C.), Warsaw, Poland, pp. 15–32.

Cardel, Y., Rico-Gray, V., Garcia-Franco, J.G., Thien, L.B. 1997. Ecological Status of *Beaucarnea gracilis*, an endemic species of the semiarid Tehuacan Valley, Mexico. *Conservation Biology*, **11**: 367–374.

Czatoryski, A. 1978. Yew in the past. In The yew-*Taxus baccata* L. In: Bialobok S. (Ed.), Foreign Scientific Publications Department of National Center for Scientific, Technical and Economic Information, (For the Department of Agriculture and National Science Foundation, Washington D.C.), Warsaw, Poland, pp. 110-115

Dhar, A., Ruprecht, H., Vacik, H. 2006a. Population viability risk management (PVRM) for *in-situ* management of a *Taxus baccata* L. population in Austria. In: Society for Conservation Biology-European Section [Eds.] Diversity for Europe, 1st European Congress of Conservation Biology 22.08-26.08.2006, Eger, Hungary. p. 106.

Dhar, A., Ruprecht,H., Klumpp,R., Vacik, H. 2006b. Stand structure and natural regeneration of English yew (*Taxus baccata* L.) at Stiwollgraben in Austria. Journal of Dendrobiology*,* 56: 19 – 26.

Gill, R.M.A., Gurnell, J., Trout, R.C. 1995. Do woodland mammals threaten the development of new woods? In: Ferris-Kahn, R. (Ed.), The ecology of woodland creation. Wiley, Chichester, pp. 201–224.

Haeggström, C.A. 1990. The influence of sheep and cattle grazing on wooded meadows in a land, SW Finland. *Acta Botanica Fennica*, **141**: 1–28.

Herz, H., Bernhard, A., Nebenführ, W., Slunsky, R., Litschauer, R., Heinze, B. 2005. Das Eibenvorkommen in den österreichischen Generhaltungswäldern. Poster bei der "12. Tagung der Eibenfreunde", Kempten im Allgäu, 29.9.-2.10.2005.

Hulme, P.E. 1996. Natural regeneration of yew (*Taxus baccata* L.): micro site, seed or herbivore limitation. *Journal of Ecology*, **84**: 853–861.

Izdebski, K. 1956. Drzewai krzewy rezerwatu cisowego Wierzchlas i struktura biologiczna drzewostanu. *Zeszyty Naukowe UMKW Toruniu, Biologia*, **1**: 5–41.

Iszkulo, G., Boratyński, A. 2006. Analysis of the relationship between photosynthetic photon flux density and natural *Taxus baccata* seedlings occurrence. *Acta Oecologica*, **29** (1): 78–84.

Iszkulo, G., Boratyński,A., Didukh, Y., Romaschenko, K., Pryazhko, N. 2005. Changes of population structure of Taxus baccata during 25 years in protected area (the Carpathian Mountains, East Ukraine). *Polish Journal of Ecology*, **53** (1): 13-23.

Jahn, G. 1991. Temperate deciduous forest of Europe. In: Röhrig, E., Ulrich, B. (Eds.), Temperate deciduous forest, vol. 7. Elsevier, Amsterdam, pp. 377–520.

Kelly, D.L. 1981. The native forest vegetation of Killanery, southwest Ireland: an ecological account. *Journal of Ecology*, **69**: 437–472.

Kelly, D.L. 1975. Native woodland in western Ireland with especial reference to the region of Killarney. PhD Thesis, University of Dublin, Ireland.

Krol, S. 1975. Zarys ekologii. In: Bialobok, S. (Ed.), Cis *Taxus baccata* L. Nasze drzewa lesne., PWN, Warszawa-Poznan, pp. 78–103.

Kościelny, S., Król, S. 1965. Wstępne wyniki badań nad wpływem czynników warunkujących naturalne odnawianie się cisa. *Rocznik Wyższej Szkoły Rolniczej, Poznań*, **27**: 102–107.

Kwit, C., Horvitz, C.C., Platt, W.J. 2004. Conserving slow growing, long lived tree species: Input from the demography of a rare under story conifer, *Taxus floridana*. *Conservation Biology*, **18**: 432-443.

Lane, C.R., Belles, P.A., Hughes, K. J. D., Tomlinson, A.J., Inman, J.A., Warwick, K. 2004. First report of ramorum dieback (*Phytopthera ramorum*) on container-grown English yew (*Taxus baccata*) in England. *Plant Pathology*, **53**: 522.

Lilpop J., 1931. Stanowisko cisow na hysej Gorze pod Starym Zmigrodem. [The yew stands on hysa Gora near Stary Zmigrod]. Ochrona Przyrody, 9: 209.

Małgorzata, F.J. 2004. Conservation of common yew (*Taxus baccata* L.) in Poland. In Vančura K., B. Fady, J. Koskela and Cs. Mátyás, (Eds), Conifers Network, Report of the second (20–22 September 2001, Valsaín, Spain) and third (17–19 October 2002, Kostrzyca, Poland) meetings. International Plant Genetic Resources Institute. Rome, Italy, P 31–34.

Meinhardt, H. 1996. Eibenvorkommen in Thüringen und Probleme Der Eibenverjüngung. In: Beiträge zur Eibe. Kölbel M., Schmidt O. (eds.), Bericht aus der Bayerishen Landesanstalt für Wald und Forstwirtschaft 10: 04.

Mitchell, F.J.G. 1988. The vegetational history of Killarnery oak woods, SW Ireland: evidence from fine spatial resolution pollen analysis. *Journal of Ecology*, **76**: 415–436.

Mossadegh, A. 1971. Stands of *Taxus baccata* in Iran. *Revue Forestiere Francaise*, **23** (6) : 645–648.

Müller, F., Schultze, U. 1998. Das österreichische Programm zur Erhaltung forstgenetischer Ressourcen.. In: Geburek Th., Heinze B. (Eds.), Erhaltung genetischer Ressourcen im Wald.. Ecomed, pp 120–135.

Niklfeld, H. 2005. (Ed.). Rote Listen gefährdeter Pflanzen Österreichs. Grüne Reihe des- Bundesministeriums fur Umwelt, Jugend und Familie, p.10.

Pridnya, M.V. 1984. Phytocenotic status and structure of Khosta common yew population in the Caucasus Biosphere Reserve. *Soviet Journal of Ecology*, **15**: 1–6.

Russ, W. 2005. Verbreitung seltner Holzgewächse nach der Österreichischen Waldinventur. *BFW Praxis Information*, **6**: 3–5.

Sauvage, C.H. 1941. L'if dans le Grandatlas. Bull. *Sci Nat. du. Maroc*, **21**: 82–90.

Scheeder,Th. 1994. Die Eibe (*Taxus baccata*): Hoffung für ein fast verschwundenes Waldvolk. IHW-Verlag, Eching.

Schadauer, K., Hauk E., Starlinger F. 2003. Daten zur Eibe aus der Österreichischen Waldinventur. *Der Eibenfreund*, **10**: 15–18.

Strouts, R.G. 1993. Phytophthora root diseases. Arboriculture Research Note, 58/93/PATH.

Svenning, J.-Ch., Magárd, E. 1999. Population Ecology and conservation status of the last natural population of English yew *Taxus baccata* in Denmark. *Biological Conservation*, **88**: 173–182.

Thomas, P.A., Polwart, A. 2003. *Taxus baccata* L. biological flora of the British Isles 229. *Journal Ecology*, **91**: 489–524.

Tittensor, R.M. 1980. Ecological history of yew *Taxus baccata* L. in Southern England. *Biological Conservation* **17**: 243–265.

Vacik, H., Oitzinger, G., Georg, F. 2001. Population viability risk management (PVRM) zur Evaluierung von in situ Erhaltungsstrategien der Eibe (*Taxus baccata* L.) in Bad Bleiberg. [Evaluation of situ conservation strategies for English yew (*Taxus baccata* L.) in Bad Bleiberg by the use of population viability risk management (PVRM)]. *Forstwissenschaftliches Centralblatt*, **120**: 390–405.

Williamson, R. 1978. The great Yew Forest. London: Macmillan,.